# Weather-Responsive Traffic Signal Control in Utah

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Utah Department of Transportation

2014 Road Weather Management
Stakeholder Meeting – SLC Utah
August 14, 2014

# Utah Department of Transportation

- Population 2.9 Million (34th largest state)
  - 2nd fastest growth
  - Projects up to 2.5 million more by 2050
- Land Area: 84,900 sq. mi (13th largest state)
- 1900 Traffic Signals in Utah
  - 1150 owned by UDOT
  - 750 owned by cities /counties


# WRTM Signal Timing Research In Utah

1) "Modifying Signal Timing During Inclement Weather"

   University of Utah – January 2001

2) "Utah DOT Weather Responsive Traffic Signal Timing"

   Texas A&M Transportation Institute & Battelle – Sept. 2013

3) "SR-36 Snow Event using Link Pivot"

   Purdue University – April 2014

4) "Implementation of a Weather Responsive Traffic "Estimation and Prediction System (TrEPS) for Signal Timing at Utah DOT"

   Northwestern University & SAIC – July 2014

UDOT udot.utah.gov

# 1) Modifying Signal Timing During Inclement Weather – January 2001 University of Utah

## Conclusions of Research

- Saturation flows decrease by 20%
- Speeds decrease by 30%
- Start-up lost times increase by 23%

## UDOT Outcome

- Generated WRTM signal timing plans
  - Model 10 mph reduction in speed
  - Duration of speed reduction estimated 20+ minutes
  - Developed WRTM plans for several corridors
  - Had no way evaluating the "effect" of the plans

UDOT udot.utah.gov

# 2) Utah DOT Weather Responsive Traffic Signal Timing – Sept 2013 – Texas A&M & Battelle

## What We Did

- Used in-house meteorologist to identify best time to implement weather based plans.
- Automated Signal Performance Metrics to actively adjust signal timing plans for each event.
  - Near real-time speed metrics to start / stop plans.
  - Purdue Coordination Diagrams (PCD's) to measure and fine-tune plans.
    - Percent Arrivals on Green and Platoon Ratios

- UDOT Outcome:

  Maintained traffic conditions during adverse weather to near non-weather levels"

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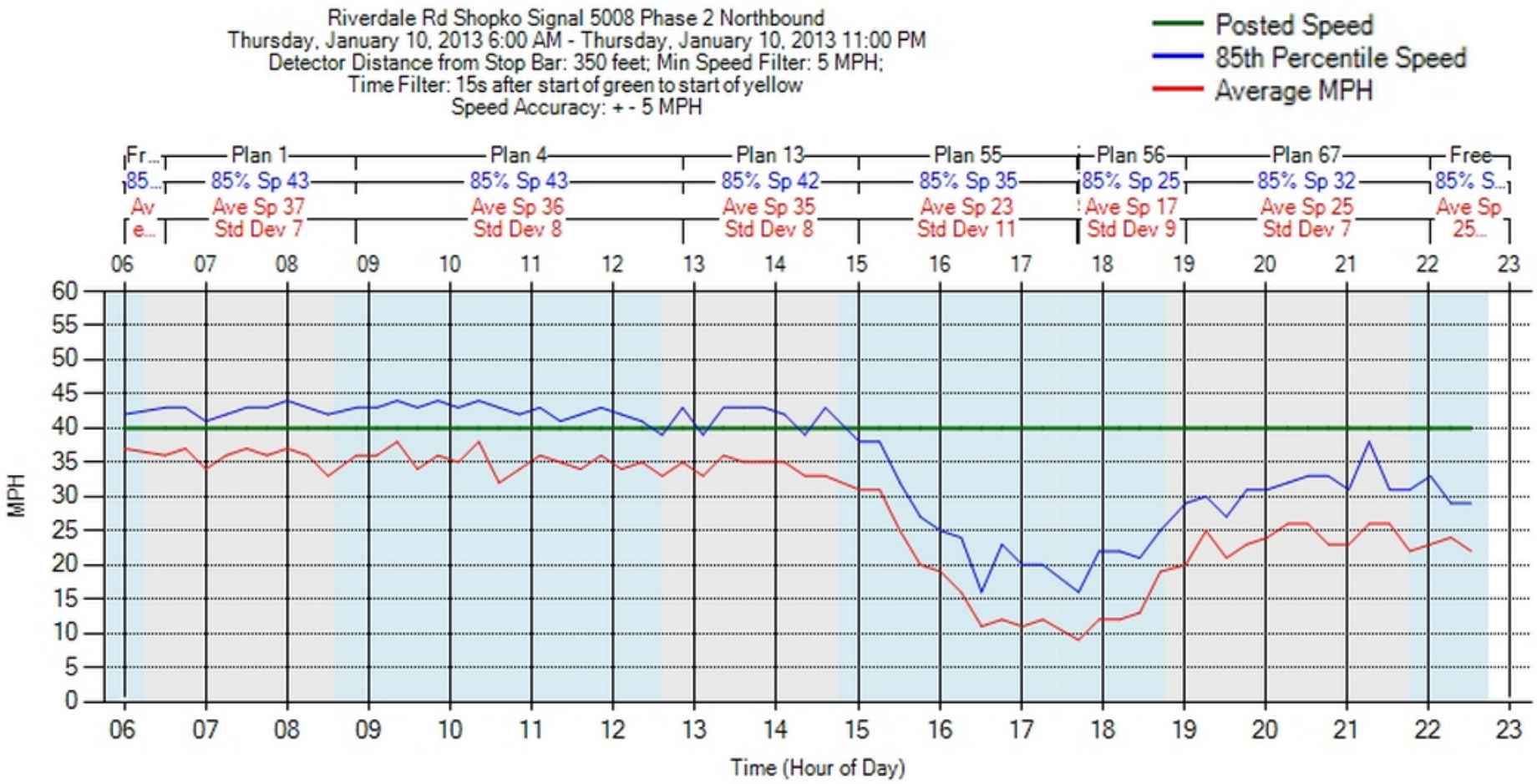
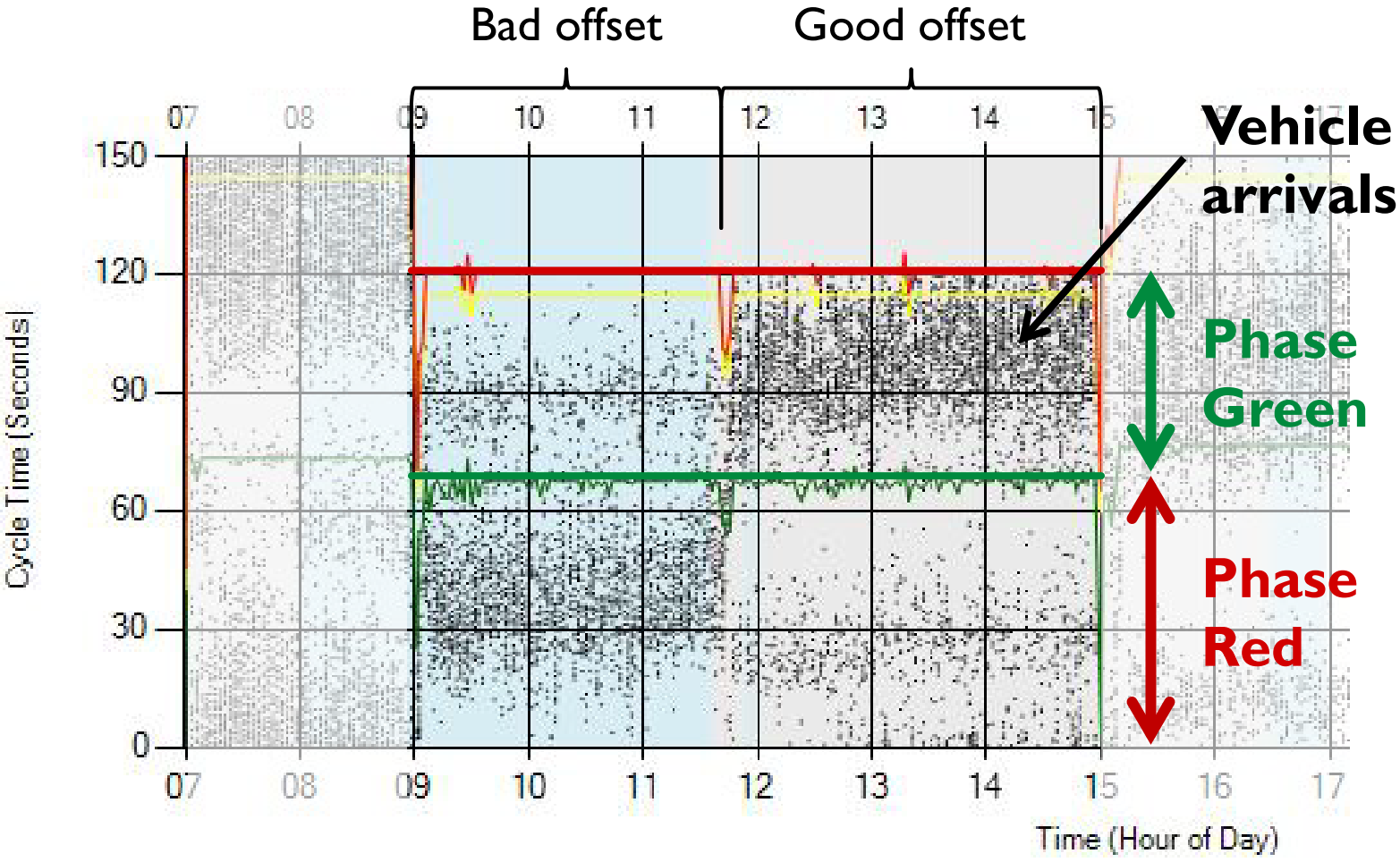
# Approach Speeds using Radar at Intersections
## (Riverdale Rd & Shopko – January 10, 2013)



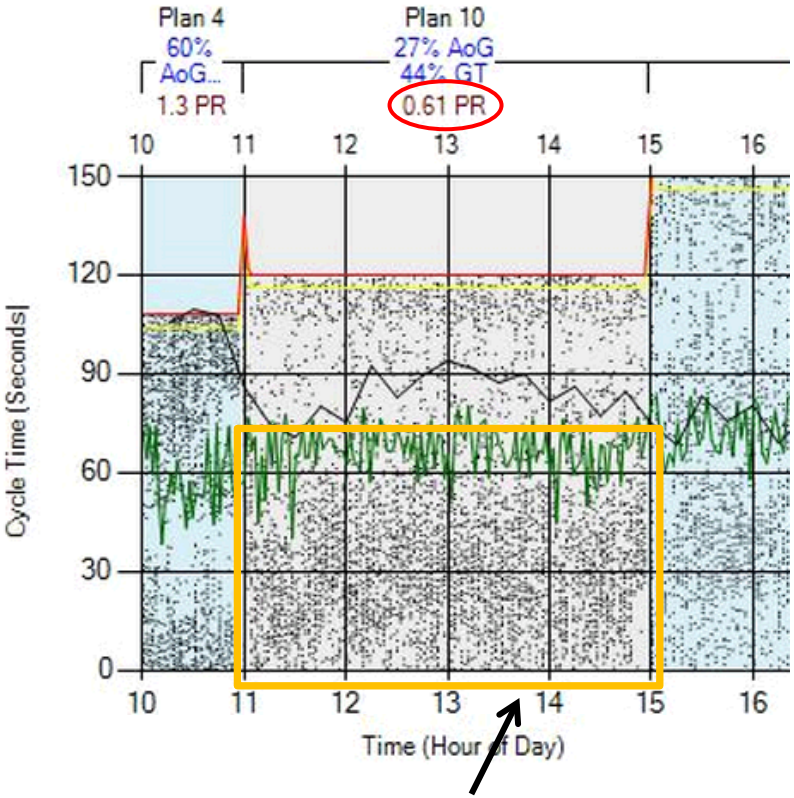
# Purdue Coordination Diagram (PCD)

- Fine-tuning new coordination plans at traffic signals

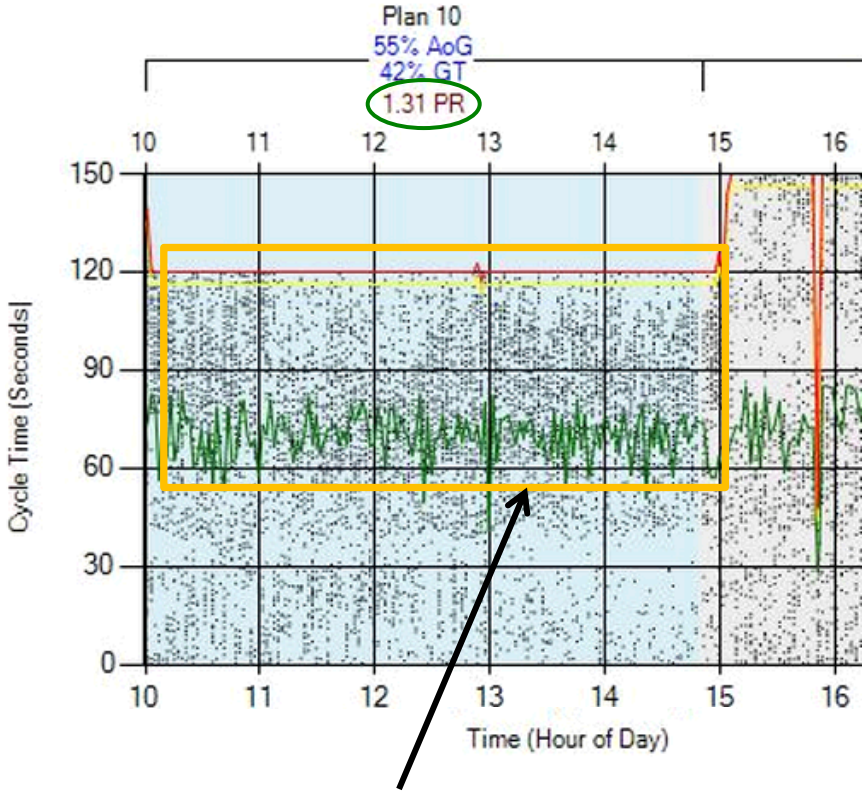


# Coordination: Improving Progression

Purdue Coordination Diagrams




Platoon arrives on red




Platoon arrives on green

# Signal Performance Metrics

An AASHTO TIG-sponsored Technology

Charts | Reports | Log Action Taken | Links | FAQ

->Signal Metrics

**Selected Signal**

7376 5600 West SR-201 Westbound

**Signals**

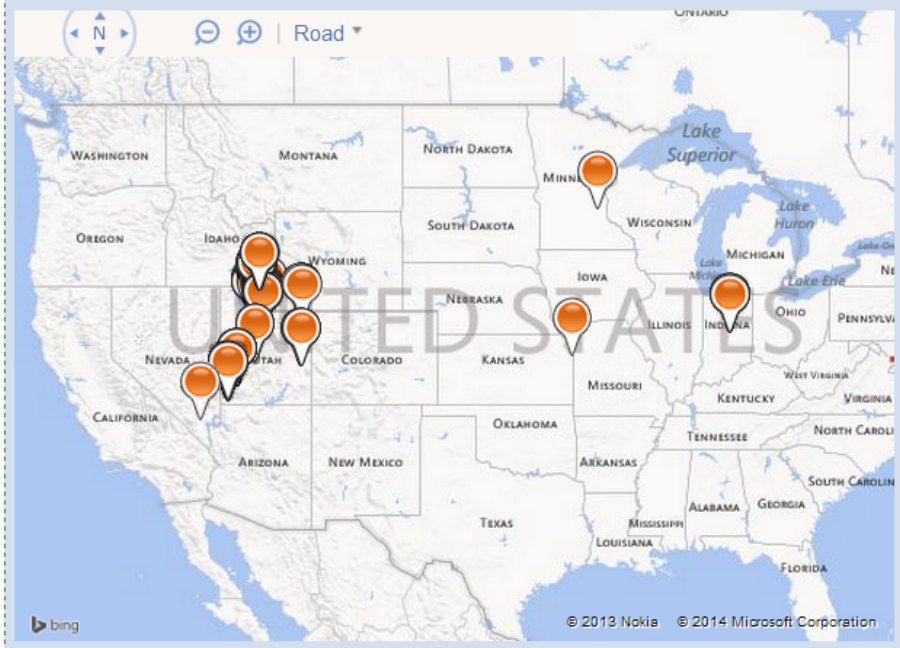
Region: All

Metric Type: All

Filter: Signal Id | Filter | Clear Filter

**Signal List**

**Map**




Create Metrics

**Metric Settings**

**Metric Type**

- Approach Delay
- Approach Volume
- Arrivals On Red
- Purdue Coordination Diagram
- Purdue Phase Termination
- Speed
- Split Monitor

Y Axis Maximum:

Percentile Split: 85

- Show Plan Stripes
- Show Ped Activity
- Show Average Split
- Show % Max Out/ Force Off
- Show Percent Gap Outs
- Show Percent Skip
- Upload Current Data

**Dates**

Start Date: 5/1/2014 ... 12:00 AM

End Date: 5/1/2014 ... 11:59 PM

Reset Date

< May 2014 >

| Sun | Mon | Tue | Wed | Thu | Fri | Sat |
|---|---|---|---|---|---|---|
| 27 | 28 | 29 | 30 | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**http://udottraffic.utah.gov/signalperformancemetrics**

# Automated Traffic Signal Performance Measures

## AASHTO Innovation Initiative (formally TIG)
## 2013 Focus Technology

Mission: Investing time and money to accelerate technology adoption by agencies nationwide

AASHTO
Innovation Initiative

AASHTO
THE VOICE OF TRANSPORTATION
AASHTO INNOVATION INITIATIVE

# 3) "SR-36 Snow Event using Link Pivot"

Purdue University – April 2014

## What We Did

- Automatic offset optimization using Purdue's "Link Pivot".
- In development at UDOT is a program to calculate this automatically using data from the PCD's.

## UDOT Outcome

- New offsets generate a 5% increase of Percent Arrivals on Green.
- Using historical measured data is a convenient way to develop WRTM plans in the future.

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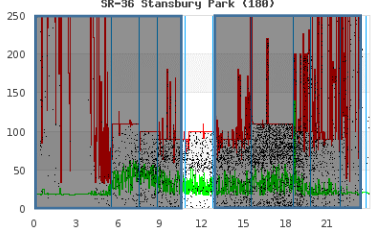
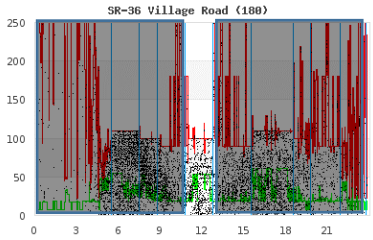
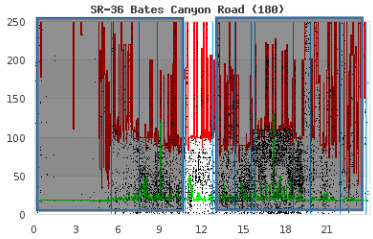
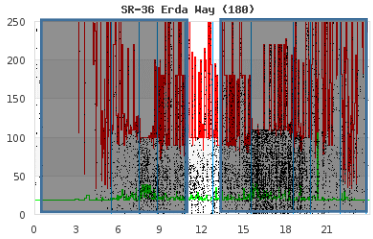
# Before

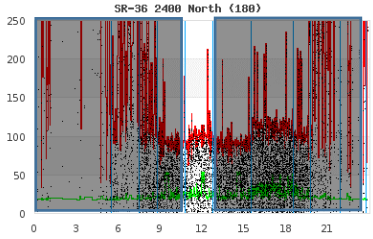
Before AOG: 6136

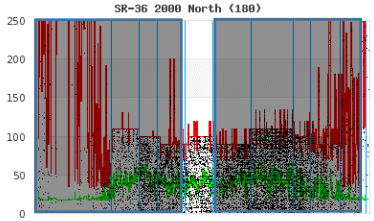


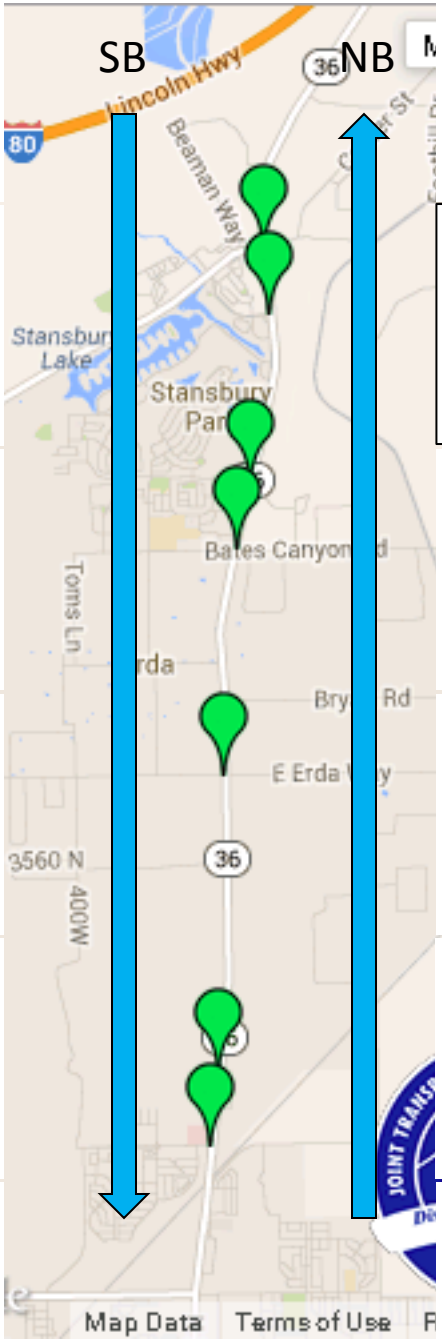



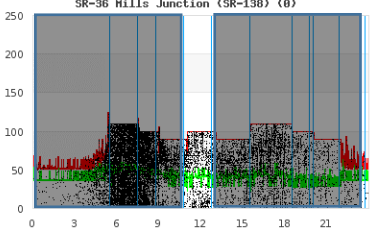



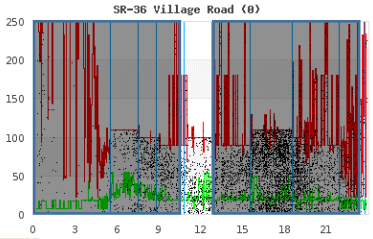



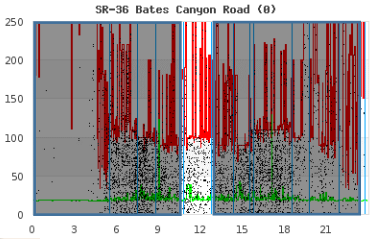



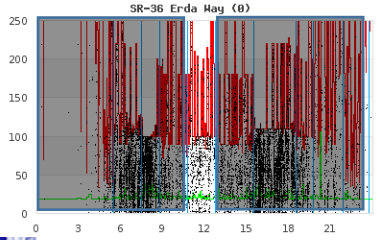



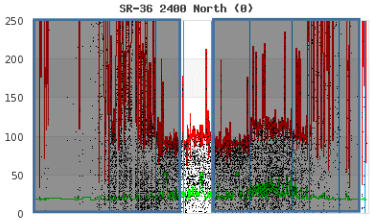

*T-Intersection*

*Northbound Is Always Green*



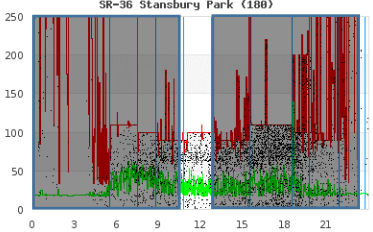

<u>Study Corridor:</u>
SR-36 Tooele

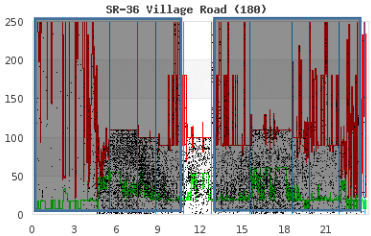
<u>Data Sampled:</u>
December 3, 2013
Snow event
1100-1300 (Plan 7)

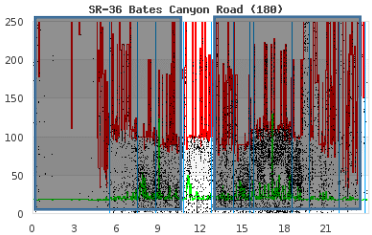
<u>Cycle Length:</u>
100 seconds

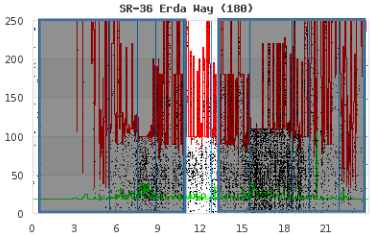
# Predicted

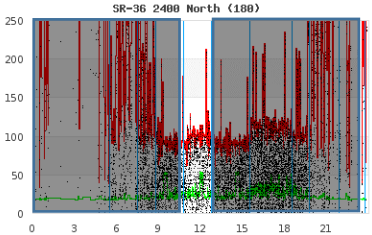
Before AOG: 6136
Predicted AOG: 6437
**Difference: +301 (+5%)**

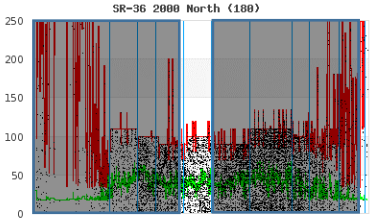


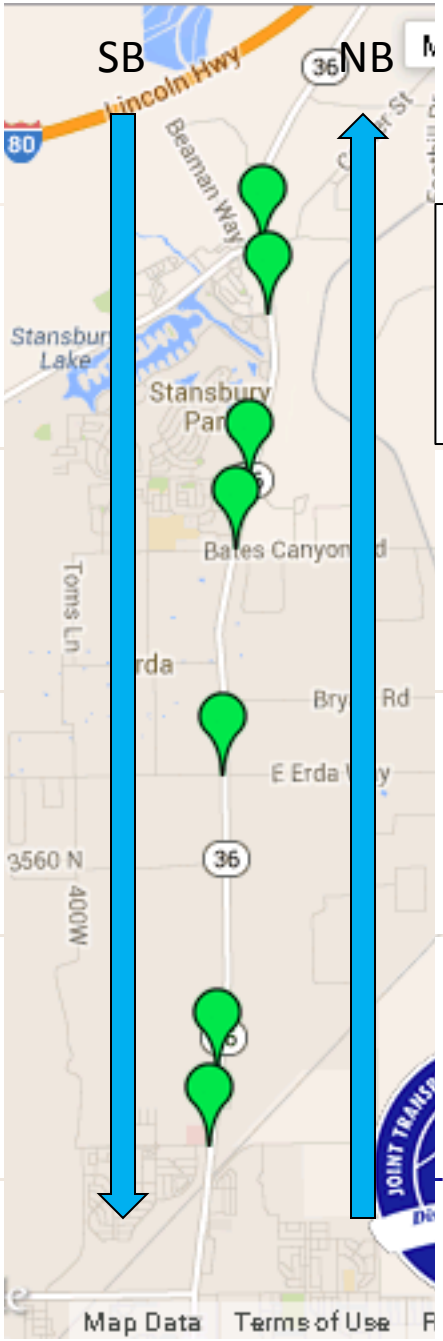



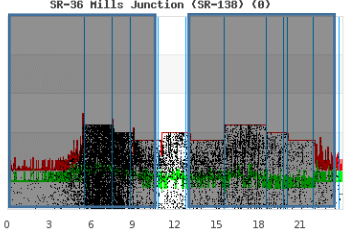

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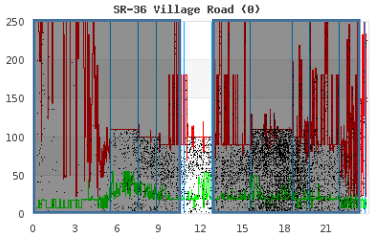


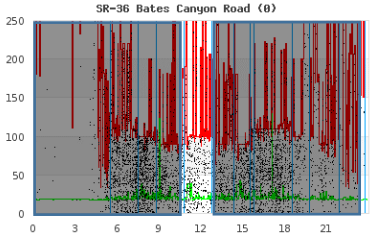


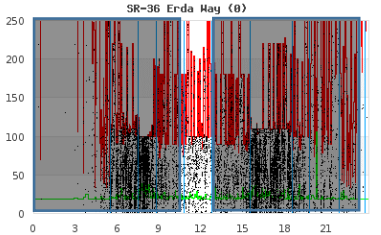


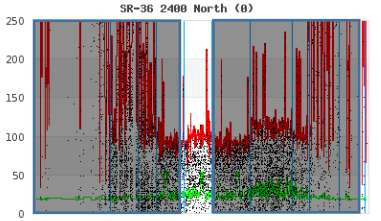


Study Corridor:
SR-36 Tooele

Data Sampled:
December 3, 2013
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1100-1300 (Plan 7)

Cycle Length:
100 seconds

# 4) Implementation of a Weather Responsive Traffic Estimation and Prediction System (TrEPS) for Signal Timing at Utah DOT – Sept 2013 – Texas A&M & Battelle

## What We Did

- NW University developed a model that interacts continuously to traffic data and provides real-time estimates of traffic conditions, network flow patterns and routing information. It predicts up to 1 hour in advance.

## UDOT Outcome:

Loaded program onto UDOT computer during spring of 2014. Have not yet had a snow storm to run the estimation and prediction model.

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# Thank You!


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